

By: David Nissim

# MATERIALS MATTER!

Volume 2

## ALL ABOUT ALUMINUM

What are the  
characteristics  
of Aluminum?

WHAT DOES AN  
ALUMINUM  
CRYSTAL LATTICE  
LOOK LIKE?

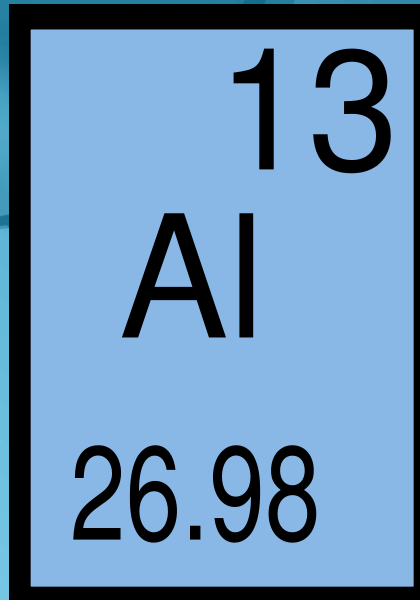
*Aluminum at the  
Ontario Science Centre!*

# What's with Aluminum?



The existence of Aluminum was proposed by Antoine Lavoisier in 1787, named by Sir Humphry Davy in 1807, and finally isolated by Hans Christian Orsted in 1825. Aluminum has become an increasingly important material in our society. Due to its light weight, high strength, and resistance to corrosion, it is an ideal material for all sorts of applications. We use aluminum in automotive construction, food and drink packaging, building construction, aerospace equipment, and so much more.

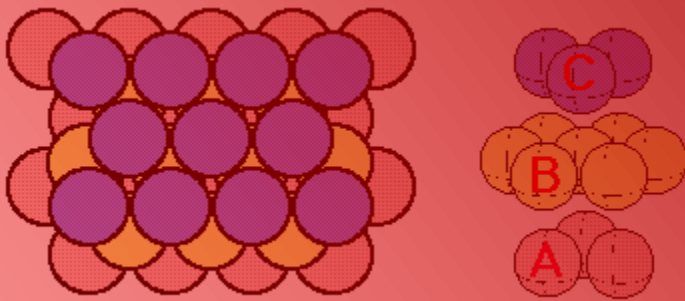
Aluminum is the third most abundant element in the Earth's crust, accounting for approximately 8% of the Earth's weight. It has no natural isotopes, and is normally only found in an oxidized state in nature. It is a soft, durable, malleable metal, and is silvery in appearance. Its atomic number is 13, atomic mass is approximately 26.98154 amu, and density is 2.70 g/cm<sup>3</sup> at room temperature. Aluminum's melting point is 933.47 K, and its boiling point is 2792 K.



Melting Point	Boiling Point	Atomic Mass	Atomic Number	Density	Electron Configuration
933.47 K	2792 K	26.98154 amu	13	2.70 g/cm <sup>3</sup>	1s <sup>2</sup> 2s <sup>2</sup> 2p <sup>6</sup> 3s <sup>2</sup> 3p <sup>1</sup> or [Ne] 3s <sup>2</sup> 3p <sup>1</sup>

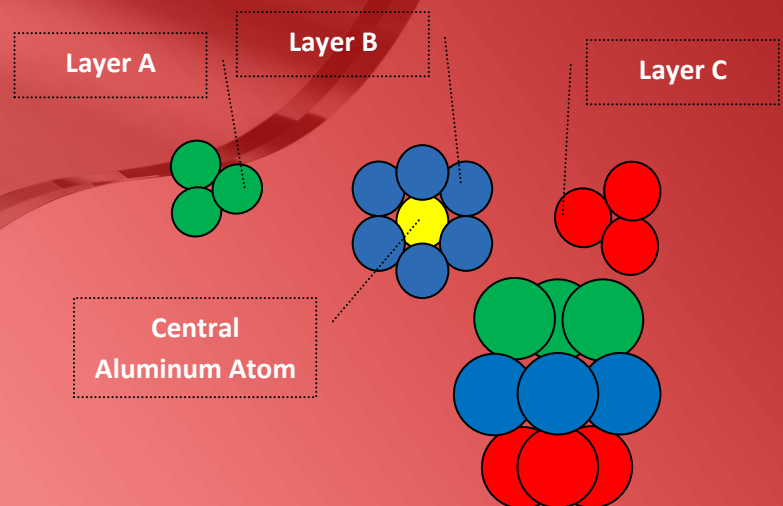


# Aluminum's Packing Structure



Being a metal, aluminum is metallically bonded, and has a crystalline structure. In metallic bonding, the valence electrons are not simply shared by neighbouring atoms, but delocalized, and migrate freely throughout the metal structure. This is why metals are such good conductors of electricity. Its structure is described as “cubic closest-packed”, or “face centred-cubic”. This structuring allows for the highest known packing efficiency of atoms (74%). The FCC lattice follows a three-plane pattern (ABCABCABC...).

The coordination number of a FCC lattice is 12. A coordination number represents the number of neighbouring atoms in a crystal around a central atom. Since FCC has the highest efficiency, it also has the highest coordination number known to be possible.



Bonding Type	Structure Type	Packing Efficiency	Lattice Pattern	Coordination Number
Metallic	Face Centred-Cubic or Cubic Closest-Packed	74%	ABCABCABC...	12

# Aluminum in the exhibit

## “Lead is the Heaviest Metal Right?”

Aluminum can be found in one of the most exciting places in the world, the Ontario Science Centre! What purpose does it serve there? It is in an exhibit called “Lead is the Heaviest Metal Right?”.

The purpose of this exhibit is to demonstrate the significance of atomic mass. It does this by comparing the metals Uranium, Lead, and awesome Aluminum! It has the same volume of each metal, except the lead is a lot harder to lift than the aluminum, and the uranium is even harder still.

What accounts for this difference? That would be the atomic mass of the atoms. This is a fair comparison of the three metals, since they all have similar packing structures, therefore the only difference in density would be accounted for by their atomic mass ( $D=M/V$ ). Both aluminum and lead have “face centred-cubic” packing structures, and uranium has a hexagonal close-packing” structure, and both these types of packing structures have a coordination number of 12.

Aluminum’s relatively small atomic mass, and similar packing structure to lead and uranium, is what is imperative to the “Lead is the Heaviest Metal Right?” exhibit. It allows to a proper comparison and demonstrates the significance of having a small atomic mass.

Thank you for reading this month’s issue of Material Matters! We hope you enjoyed reading about aluminum! Make sure to pick up next month’s issue to see what new material you can learn about, or check out last week’s issue on Teflon!

